DOCUMENT RESUME

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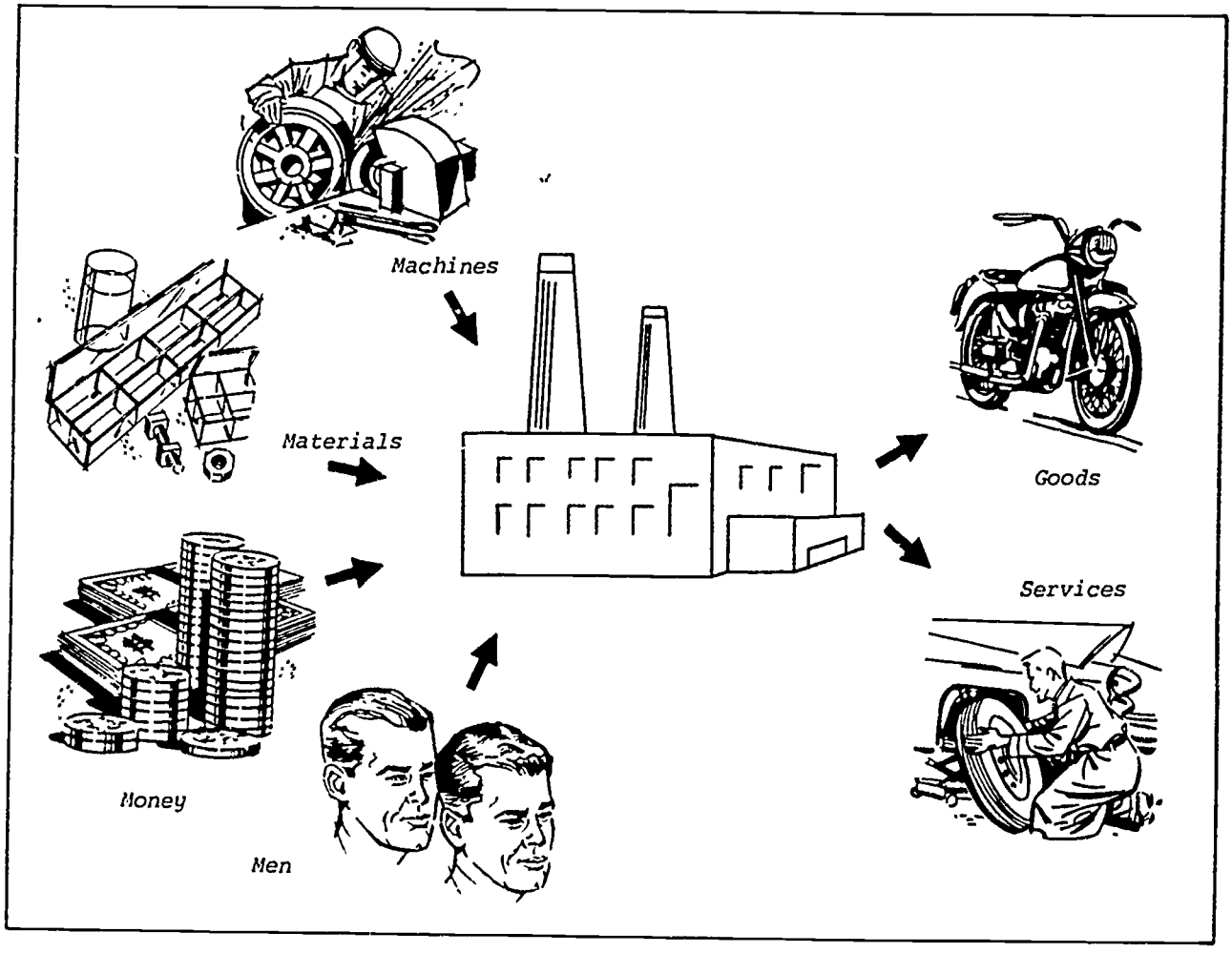
ABSTRACT

The teacher directed problem solving activities package contains 17 units: Future Community Design, Let's Build an Elevator, Let's Construct a Catapult, Let's Design a Recreational Game, Let's Make a Hand Fishing Reel, Let's Make a Wall Hanging, Let's Make a Yo-Yo, Marooned in the Past, Metrication, Mousetrap Vehicles, The Multi System Encapsulator, Safety Card, Paper Airplane Contest, The Electro-Magnetic Crane, Egg Craft, Designing a Mobile, and Compressed Air Propulsion. Suggestions to the teacher regarding the statement of the problem to be presented, the point of view to be taken, procedures and needed materials, possible solutions to the problem, length of the project, safety notes, information for the student, and model drawings are provided where applicable. All activities pertain to field objective number 1 of the Wisconsin Guide to Local Curriculum Improvement in Industrial Education, K-12. (LH)

PROBLEM SOLVING ACTIVITIES



Prepared as an Aid in Implementing
The Wisconsin Guide to Local Curriculum
Improvement in Industrial Education, K-12

A Teacher Directed
Problem Solving Activity

Prepared as an Aid in Implementing
The Wisconsin Guide to Local Curriculum
Improvement in Industrial Education, K-12

Future Community Design

Pertaining to Field Objective One
and the following elements of industry

Research and Development Property

Marketing and Distribution Finance

Maintenance and Service

Produced by:

The Industrial Education Instructional
Materials Development Project
University of Wisconsin-Stout
Menomonie, Wisconsin

Project Director:

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Supported by:

The Wisconsin Department of Public Instruction

The Graduate College and the Center for Vocational,
Technical and Adult Education
Both of the University of Wisconsin--Stout

Future Community Design

To the student:

What kind of community would you like to live in? What would you change or retain from the community in which you now live? This design problem will give you a chance to think carefully about your own personal community of the future!

THE MAP

You are to place 50 homes, apartments, or combinations of both on the property shown on the map.

- The numbers on the contour lines show the elevation in feet represented by the contour lines. These contour lines provide a model of the terrain. You can get more information about interpreting contour lines from a Scout handbook or from a good geology or geography textbook.

- The land is all wooded with the exception of the area marked A. Area A was part of a farm until six years ago. It is covered with grasses, very young trees, and some shrubs.

- There is a major north-south highway approximately 1 mile to the east of this parcel of land, and roads leading to that highway terminate at the edge of the property as marked.

- Running across the parcel is a spring-fed stream that has a moderate flow even during dry weather.

Procedure:

How large is your parcel of land? _____
acres (43,560 sq. ft. = 1 acre)
How much land is that per living unit? _____acres

1. Living Units

Use 50 pieces of paper book matches ½" long to represent living units. Cut the head off each match end and then cut the remaining portion in half to make two units. Each living unit is equivalent to an area 25 feet by 100 feet. You can stack and arrange the matchsticks to represent apartment dwellings, trailers, and private homes. Color code the building models.

2. Build a Model

Make a three-dimensional map of your development. This can be done by cutting out corrugated cardboard in the shape of the contour lines and then stacking the pieces. The type of corrugated board used in many packing boxes (about 1/16" thick) makes the contour lines about 12 feet in elevation. (This is the reason for the contour scale of 12 feet rather than 10 feet.) You will need five 9 x 12-inch pieces of cardboard.

You can make accurate copies of a contour line. Put carbon paper on the cardboard, the map on top of that, and trace a contour line on a sheet of cardboard.

Cut out a rectangle the size of the entire map. The elevation of this piece is 28 feet. Match up the northwest corner of each piece. Cut the 40-ft. contour line with the NW corner in place and glue to the first rectangular piece. Then cut the next highest numbered piece and glue it on top of the previous piece.

3. Plan your community.

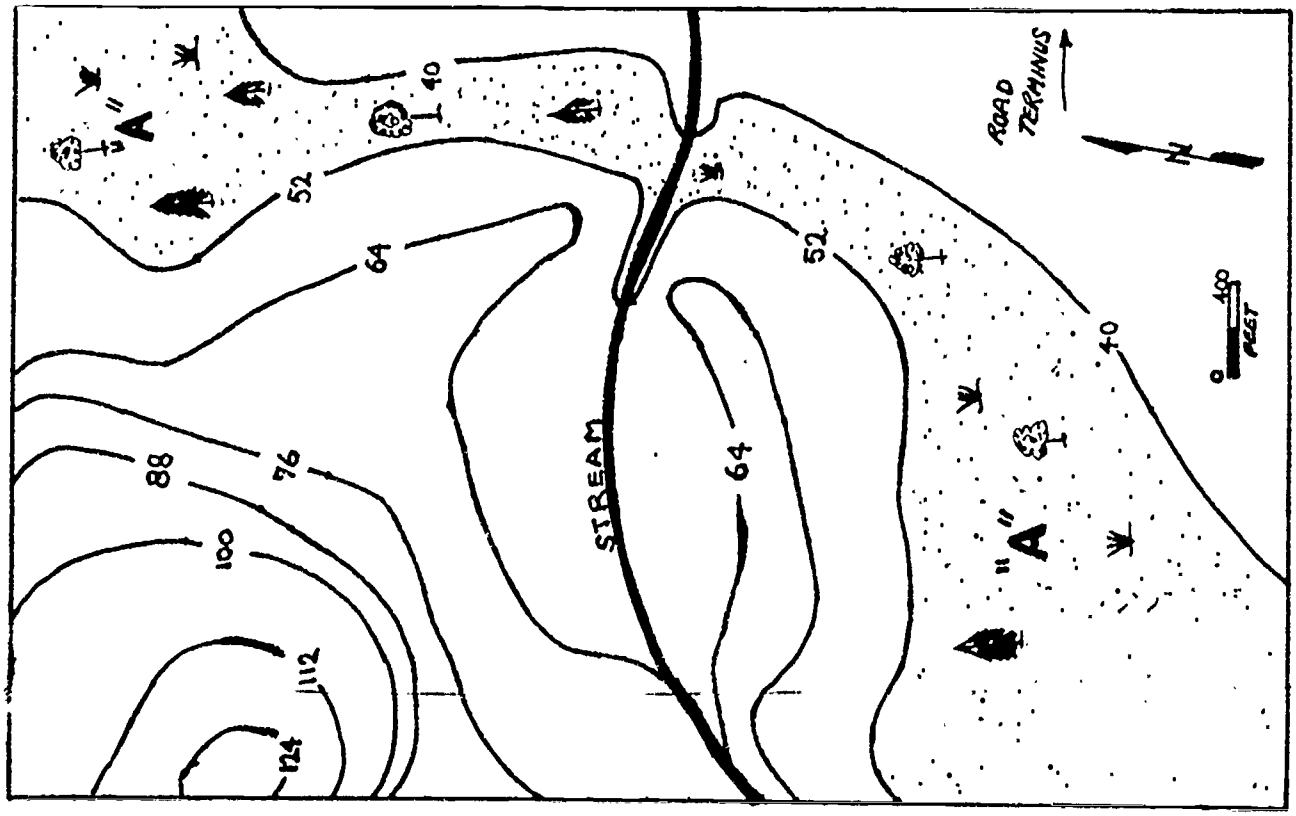
Be sure to account for the following (you may provide some of these things outside your community):

a. Power and water supplies
b. Waste removal and processing
c. Road locations
d. Minimal damage to the natural terrain
e. Recreational facilities
f. A part of total area held as public land
g. Establishment of small shopping area

4. Give your community a name.

5. Write a television commercial.

Attract buyers. Focus attention on one or more of the community's features.



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Improvement in Industrial Education, K-12

Let's Build an Elevator

Pertaining to Field Objective One
and the following industrial elements

Research and Development Production

Materials Human Resources

Communications

Produced by

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For the Teacher

Let's Build an Elevator

Problem to be Presented to the Student:

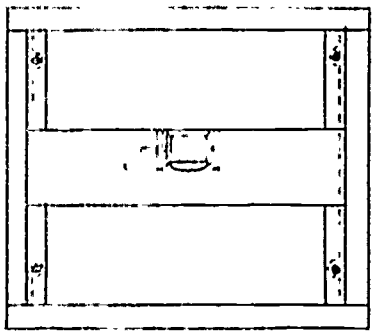
Suppose that you are an architectural engineer. The firm you work for has the job of designing a three-story building. You have been assigned the task of designing an elevator for this building. The elevator is primarily for use in transporting freight. The shaft is to have four doors, three which are for access to the three floors of the building. The fourth is opposite the doors to the three floors and provides access to a loading dock. The level of the loading dock is eight feet above the first floor level and four feet below the second floor level. The elevator cage then, must have access doors at both ends. The building will be 36 feet tall, with the distance between floors being 12 feet.

Your task is to design and build a model of an elevator suitable for use in this building. The scale of the model should be 1" = 1'. Begin your design task with the collection of information on the design and construction of elevators. Consider the following factors while you make your design: size, weight, capacity, speed, controls, and safety. Your model should include the elevator shaft, the cage, the lifting mechanism, and power for the lift. As you design the elevator, be sure to keep in mind the materials and equipment you will have available for construction your model.

Make drawings of the elevator depicting the dimensions and materials for the finished model. Your drawing should describe the model well enough so that someone else could fabricate the model with no further communication with you. Finally, manufacture the elevator model as you have designed it.

Note to the Instructor:

The elevator design project should be presented to the student as a problem for his solution. The emphasis in the project should be upon the process of solving a problem rather than on the finished article. Suggestions to students who are stumped by the problem might be best made in the form of questions which lead to solutions. Enclosed with this package is a drawing on one possible, simple solution to the problem. It could be used for a redesign approach to the problem.



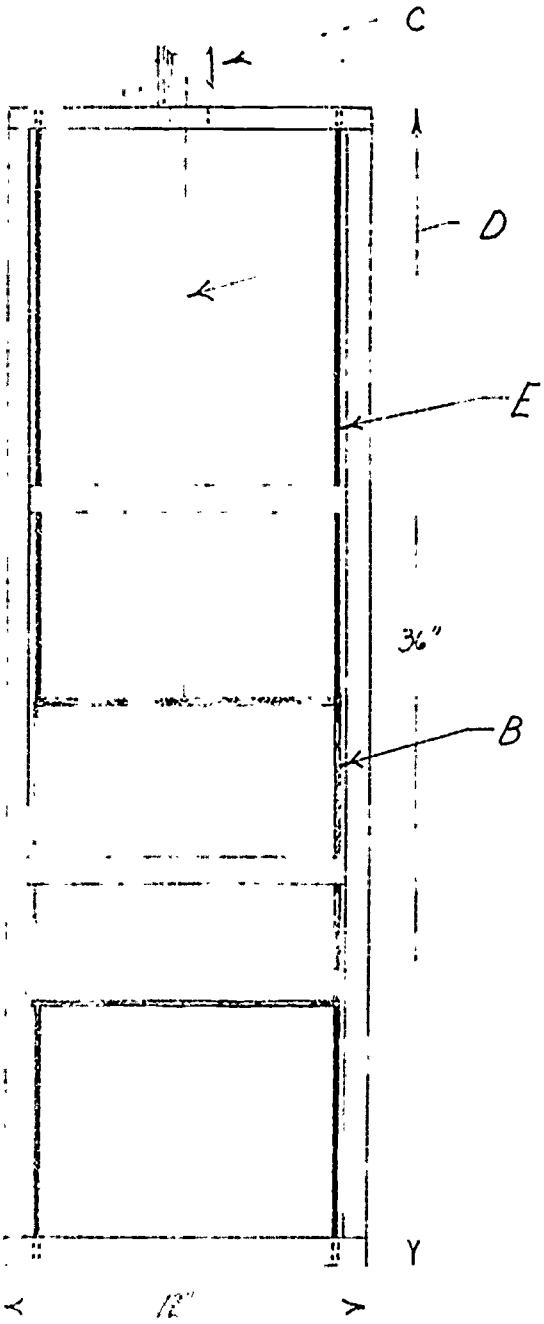
A-Wood frame, 3/4" members

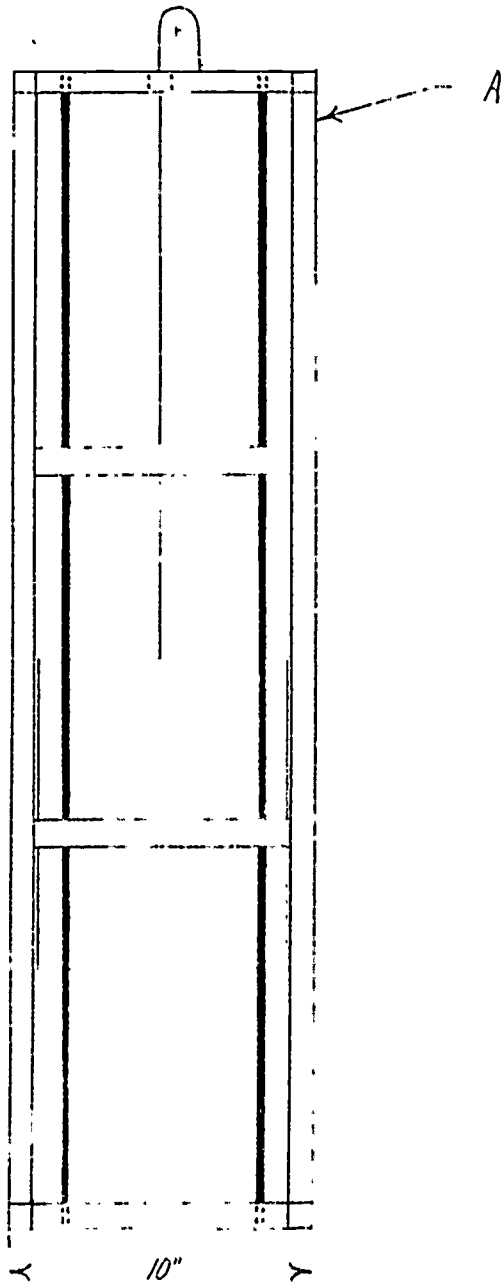
B-Cardboard or 1/4" plywood elevator cage

C-Hoisting mechanism consists of sewing thread spool mounted in frame with crank attached to axle

D-Heavy thread lift cable

E-Cage guided by 1/8" steel rods which fit into grooves on cage sides





Simple Elevator Model

A Teacher Directed
Problem Solving Activity

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Let's Construct a Catapult

Pertaining to Field Objective One
and the following industrial elements

Research and Development Production

Materials Human Resources

Communications

13/14

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For the Teacher

Let's Construct a Catapult

Problem to be presented to the Student:

Imagine yourself a medieval arms supplier. Your king's most eminent general has come to you with a tale of a device, used by a neighboring and unfriendly country's army, which is capable of throwing large rocks long distances. The device, he says, is called a catapult. He is concerned for your country's national security and he believes that the present catapult gap between the two countries could result in a defeat in future wars for your side.

He has charged you with responsibility for the design and construction of a working model of a catapult. So serious is the situation that you have only two weeks to complete the prototype model. Failure to meet the deadline will likely have dire consequences, for your king has been known to behead subjects for less serious failures.

Your model should incorporate design features which will permit it to meet the following performance criteria:

1) Throw a one ounce weight a distance of at least 30 feet.

2) Height of trajectory and distance to impact can be varied by adjustment of the catapult.

3) Unit is mobile (mounted on wheels) and light in weight

Note to the Teacher:

Included with this package is a drawing of one possible solution to the catapult design problem. Students could be directed to designs of similar, or greater or lesser complexity. Another approach would be to present the drawing as a starting point for a re-design activity. In either case, it is suggested that greater emphasis be placed upon the creative process of design rather than upon high standards of craftsmanship in production of a prototype.

Safety Note:

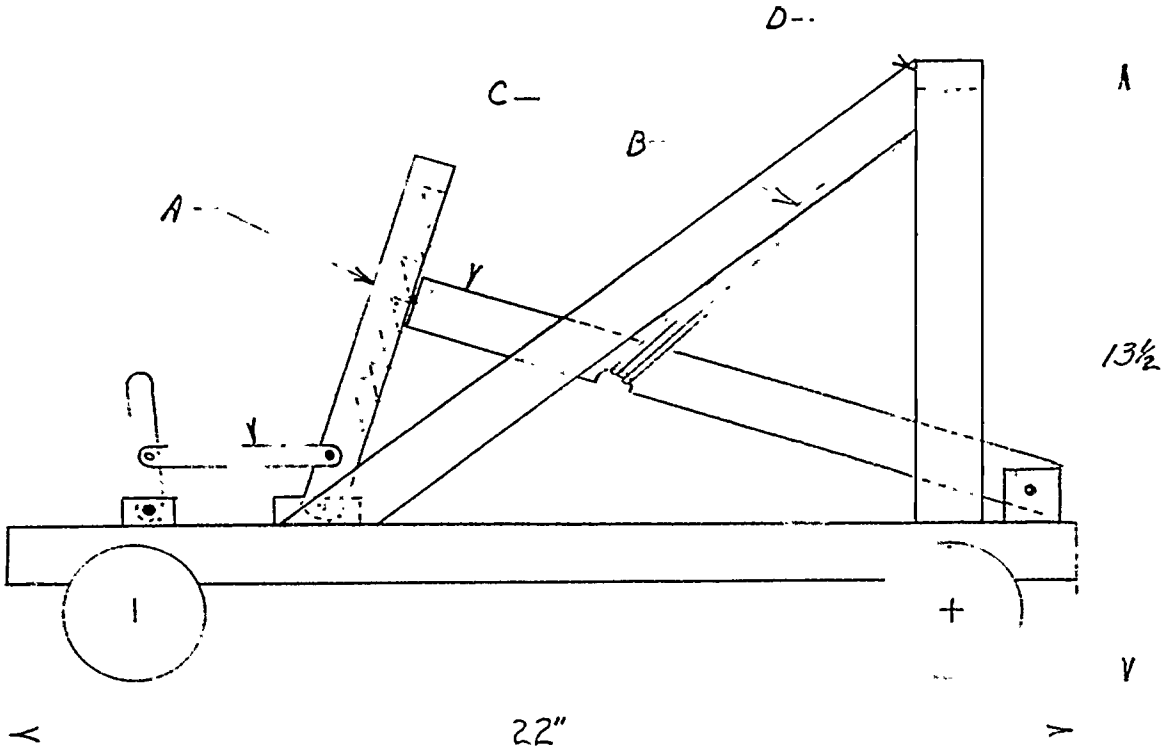
As the project nears completion, students might want to test their prototypes. This activity should be carefully supervised to avoid possible student or teacher injury!

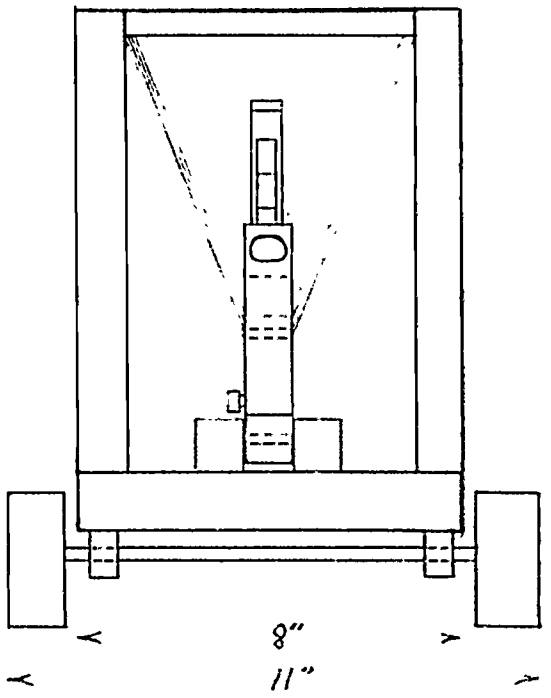
A-Ratched trigger device permits range to be varied

B-Heavy rubber bands or rubber upholstery webbing provides power

C-Depression in launch arm holds projectile

D-Rubber pad on cross bar will absorb shock of impact of launch arm





Design for Catapult

A Teacher Directed
Problem Solving Activity

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Improvement in Industrial Education, K-12

Let's Design a Recreational Game

Pertaining to Field Objective One
and the following industrial elements

Research and Development Production

Materials Human Resources

Communications

The following industrial elements can also
be incorporated into this activity

Marketing and Distribution

Finance and Management

Produced by

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For the Teacher

Let's Design a Recreational Game

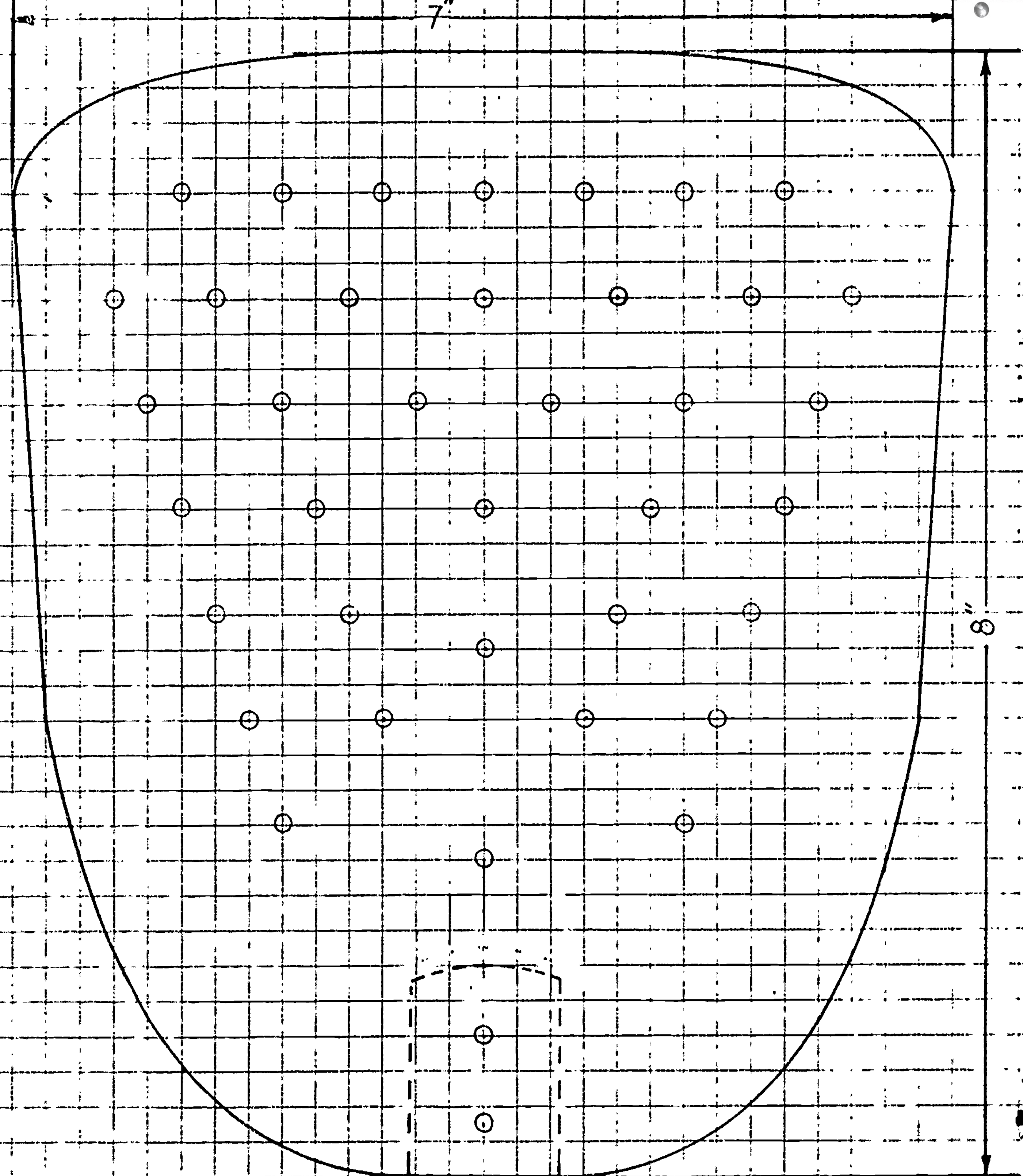
Problem: Your school is located within a heavily populated area. Your students live in areas where there exists a lot of brick playgrounds, walls, and alleys. The weather is pleasant, and it is the time of year when students have a lot of energy to burn.

The problem is to have the students develop some sort of recreational games which can be used in the recreational facilities they have available to them. The ideas can be originals that they may create themselves or replicas of equipment which is commercially produced.

Instruct the students that they may use any tools and machines for which they have received safe instruction and permission to use. They may also use any materials found in the lab and those they would like to bring from home.

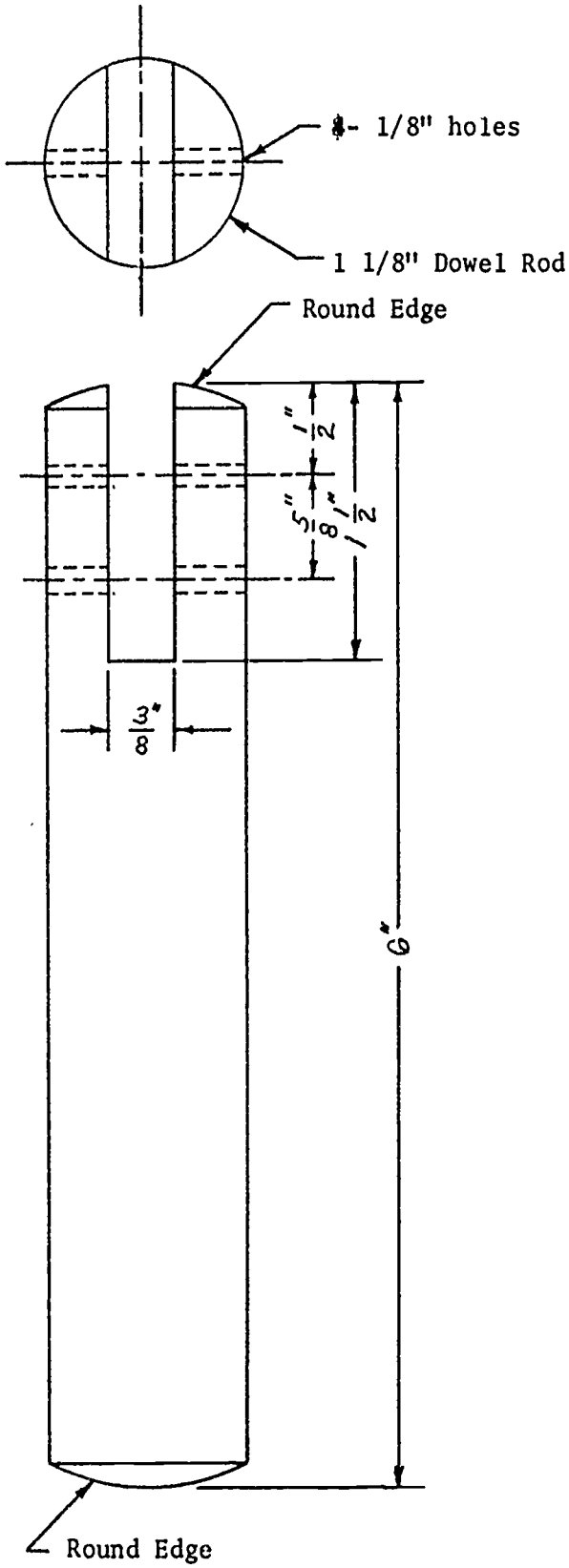
Limit the students to a week to work on the design and construction. Be sure to break the class into various groups, this way you will gather more ideas. Keep all work and evaluate it on a creative basis. Explain to the students that they should be creative. Tell them not to worry about craftsmanship, only the explanation of their ideas.

If the students come up with some practical ideas, you may wish to use these for an enterprise or mass production project. There is a possible solution to the problem on the following pages. These designs can be modified to meet the needs of the instructional situation. They may also be incorporated into designs for a production product. The solution listed here is a paddle which is to be used to play paddle ball.



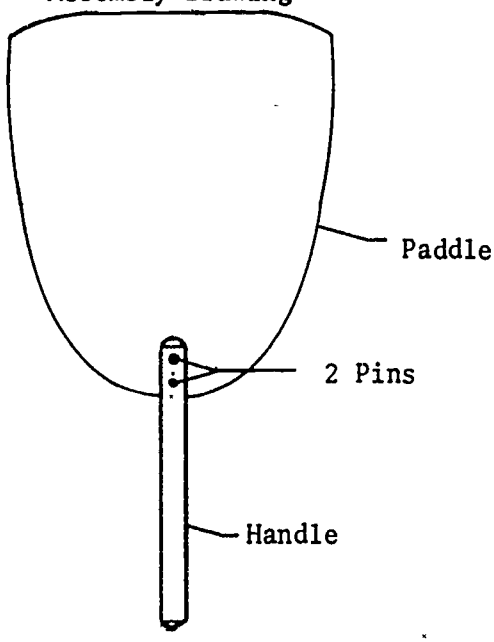
PADDLE
PATTERN

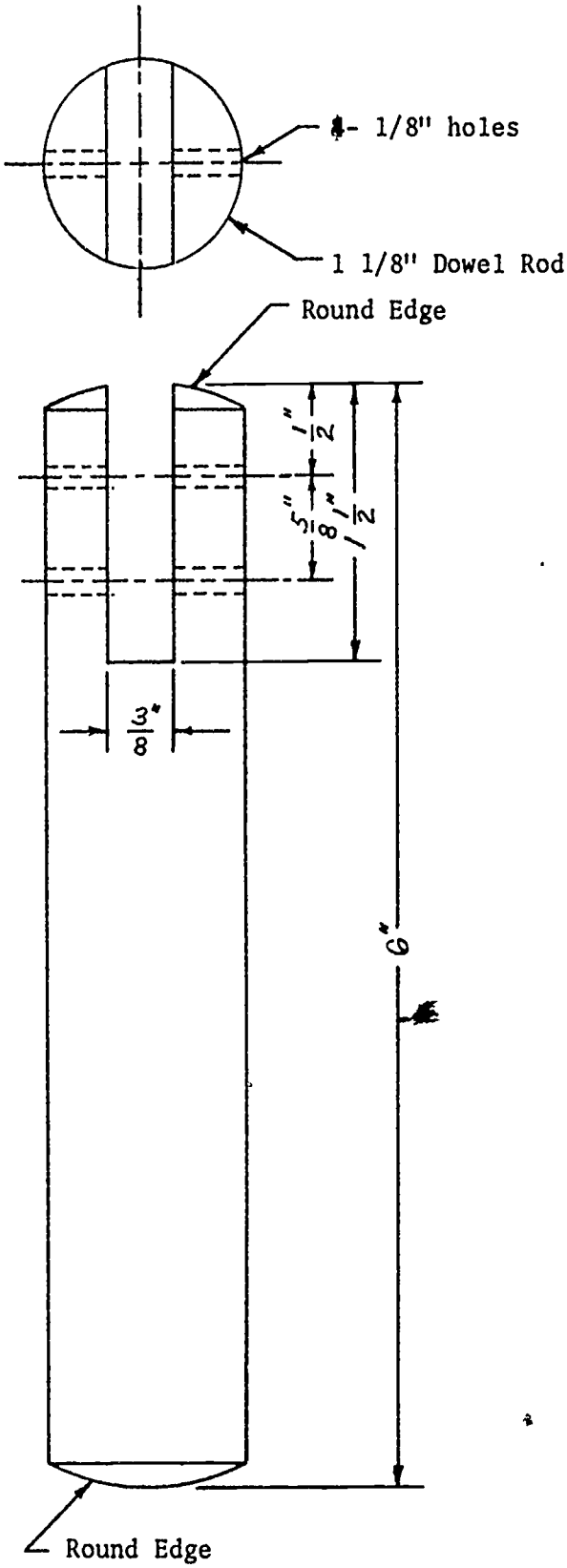
ACTUAL SIZE
ALL HOLES: 1/8"



Paddle Handle

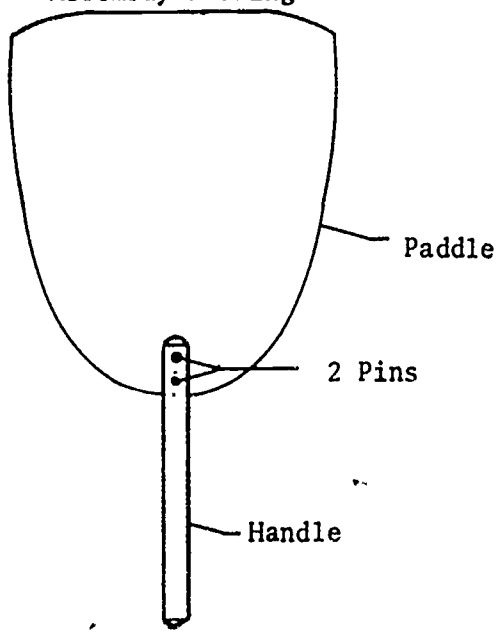
Assembly Drawing





Paddle Handle

Assembly Drawing



A Teacher Directed
Problem Solving Activity

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Let's Make a Hand Fishing Reel

Pertaining to Field Objective One
and the following industrial elements

Research and Development Production

Materials Human Resources

Communications

The following industrial elements can also
be incorporated into this activity

Marketing and Distribution

Finance and Management

Produced by

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For the Teacher

Let's Make a Hand Fishing Reel

Problem: Since fishing season extends most of the year in Wisconsin and many of the students enjoy this form of recreation, why not experiment to design a fishing device which is cheap to produce and easy to carry with you. You should present this problem to your class and see what solutions they can develop. Be sure to stress that you want a device that is cheap to make and easy to carry, but will successfully catch fish.

Instruct the students that they may use any tools and machines which they have received safe instruction and permission to use. They may also use any materials found in the lab and those they would like to bring from home.

Possible designs for the hand fishing reel could be made from wood, plastic, metal, etc. Explain to the students that they should be creative and not to worry about craftsmanship. The creativity is the important thing to look for in each design.

Limit the students to a week to work on the design and construction. Be sure to break the class into various groups, this way you will gather more ideas. Keep all work and evaluate it on a creative basis.

If the students come up with some practical solutions, you may wish to use these for an enterprise or mass production project. There is a possible solution to the problem on the following pages. These could be used as the designs for a production product.

A Possible Solution

All Seasons Hand Fishing Outfit

Materials:

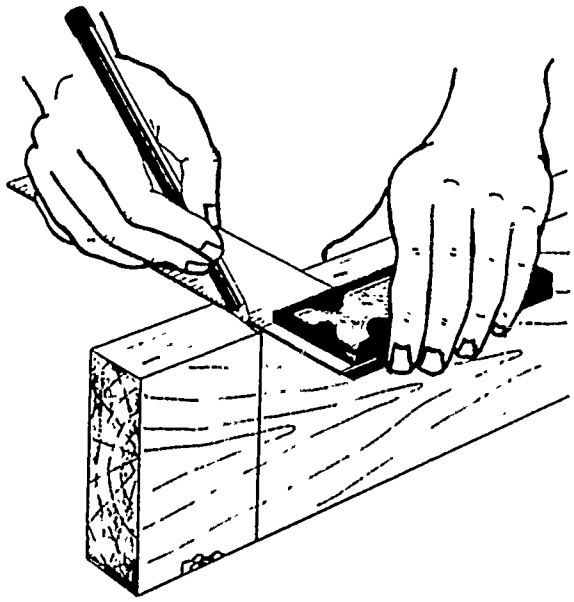
1. Block of 3/4" pine at least 6" x 3 1/2"
2. Template (pattern shown below)
3. 2 - corks

Tools and Machines:

1. Try square of combination square
2. Pencil or scratch awl
3. Hand plane
4. Jig saw
5. Rule
6. Vibrator sander
7. Wood working vise
8. Drill press vise
9. Electric hand drill
10. Drill press
11. 1/8" twist drill bit
12. 1/2" twist drill bit
13. Wood file
14. Wood rasp
15. Sand paper

Procedures:

1. Obtain a wood sample from your instructor. Square one end of the wood sample. To do this, take the sample and use a try square and a pencil or scratch awl. Scribe the line as shown in the following diagram.

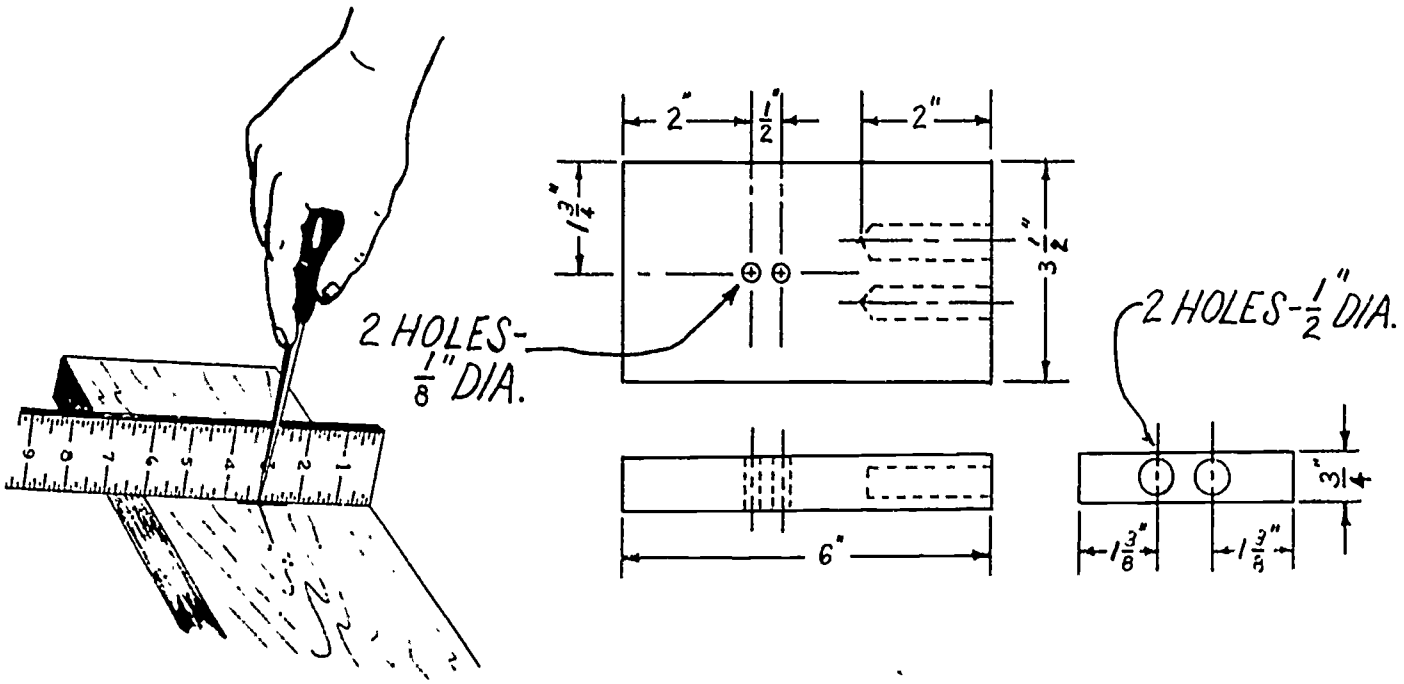


2. Using the jig saw, cut along this line.
*Remember to cut just on the waste side of the line. After you have completed this, you should have a square end.

3. If your wood block is in excess of 3 1/2" in width or the width sides are not square, you have additional steps to square your block. First check to see if these sides are square with the one end of the block you have just cut. If not, use the try square and draw additional pencil lines which are square with your first cut. Make sure the block is 3 1/2" in width. If not, draw a square line which will be 3 1/2" in width. If you only have a 1/4" or less excess width to your block, use the hand plane and bench vise to remove this. If more than 1/4" excess stock exists, use the jig saw to remove this.

4. Take a rule, try square, and pencil or scratch awl and layout a distance of 6" from the block's squared end and mark a line. With the jig saw cut along this line. When completed, you should have a block 6" in length and 3 1/2" wide.

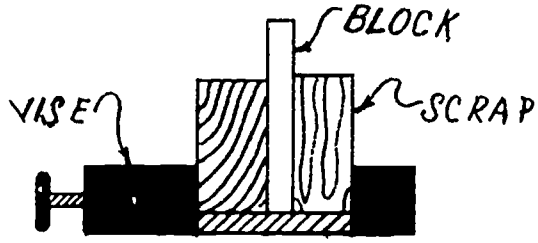
5. Now take the block and locate the centers of the following four holes.



In locating these use a pencil, rule, try square, and scratch awl as shown in the above picture.

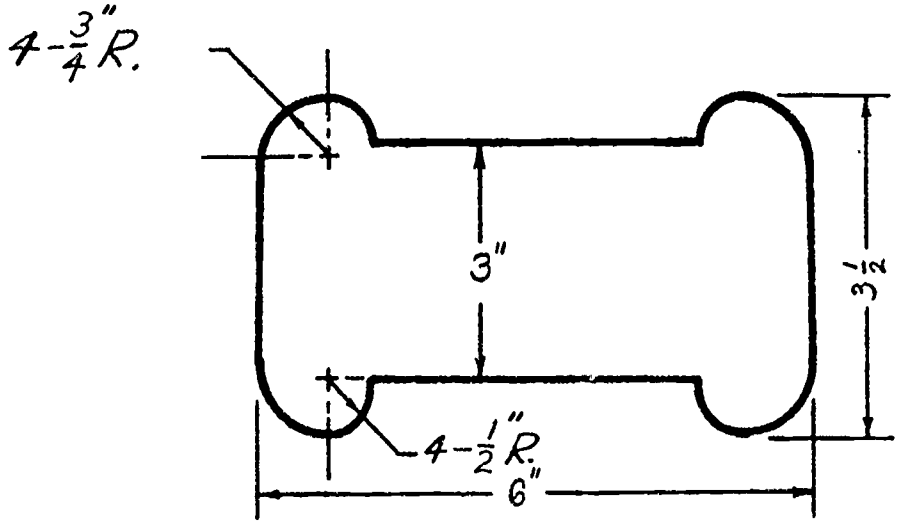
6. Using the electric hand drill and 1/8" drill bit, drill the 1/8" holes through the block. In doing this you will want to hold the block with the bench vise.

7. Take the block and place it between two scraps of wood in the portable drill press vise as shown in the picture below.



Using the drill press and the 1/2" drill bit, drill the 1/2" holes approximately 2" into the block.

8. Take the template as shown below and make the pattern of the fishing reel onto the block with a pencil.



9. Using the jig saw cut around the traced pattern.

10. Hand sand the rough edges of the block. A wood file or rasp may be required to remove some of the rough edges.

11. With the vibrator sander, smooth the large surfaces of the reel (top and bottom).

12. Label the fishing reel with masking tape which has your name and period on it. Hand the reel in for teacher evaluation.

13. When the reel is returned, place the cork in the large holes. In these holes can be stored sinkers and hooks. The small holes are there so you can tie your fishing line to the reel.

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Let's Make a Wall Hanging

Pertaining to Field Objective One
and the following industrial elements

Research and Development Production

Materials Human Resources

Communications

The following industrial elements can also
be incorporated into this activity

Marketing and Distribution

Finance and Management

3D83

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For the Teacher

Let's Make a Wall Hanging

Problem: Now that Mother's Day is coming up in a few short months, wouldn't it be nice to make a present for your mother instead of spending your allowance to buy one? Mothers like to have nice presents. They also like gifts that beautify their homes.

The problem is, "to design and construct a wall hanging for your mother." A wall hanging is an artistic display which can be hung from the wall like a picture. These are usually made from textiles, yarn, leather, clay, metal, wood, and other materials. You have probably seen cloth calendars hanging in kitchens. These are one form of wall hanging.

Your problem is to design and construct an artistic wall hanging which you would be proud to give to your mother.

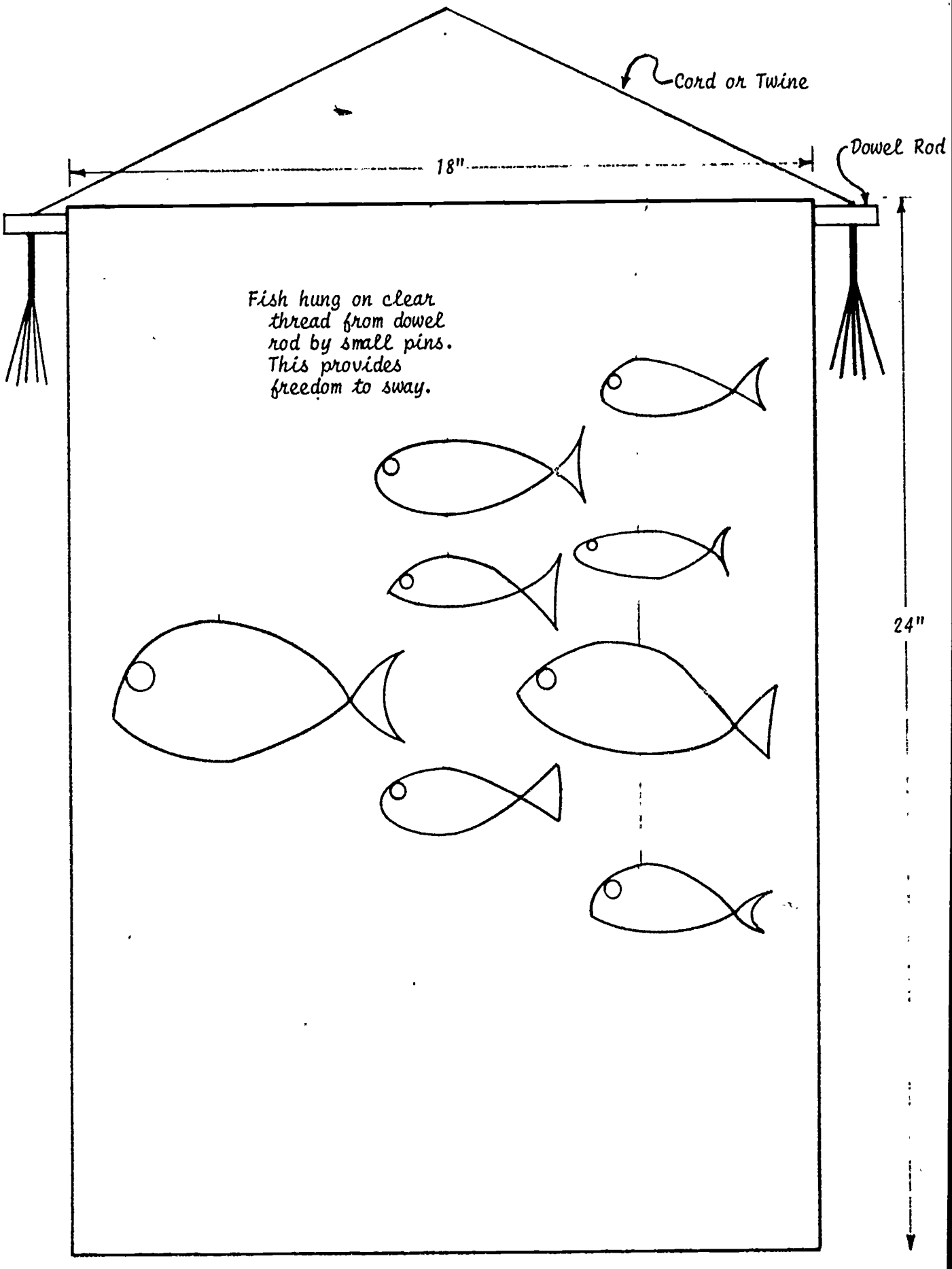
Instruct the students that they may use any tools and machines which they have received safe instruction and permission to use. They may also use any materials found in the lab and those they would like to bring from home.

Explain to the students that they should be creative and not to worry about craftsmanship. The creativity in solving the problem is the important thing to look for in each design.

Break the students into various smaller groups, this way you should be able to gather more ideas. Limit the students in the amount of time they have to work on the problem (generally one week).

After this time, stop work and let the students explain their ideas to the class. You may want to proceed using only one idea or let the students start to work individually. Students who lack creativity may get some ideas from other students.

Following is an idea you may wish to show the class to start them thinking:



Aqua Background of Felt or Burlap
Fish made of copper or brass.

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Let's Make a Yo-Yo

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For the Teacher

Let's Make a Yo-Yo

Problem: While reading one of your industrial education journals you come across an article telling you how a class produced yo-yos for a mass production project. As you read, you thought that there could be better ways to produce the same product. This interested you so you thought you would bring it to your class to find possible solutions.

The problem is, "To design and construct a yo-yo." Tell the students that they may use any tools and machines for which they have received safe instruction and permission to use. They may also use any materials found in the lab and those they would like to bring from home.

Some possible solutions could be to cut them from wood, file and cut then from metal, turn them on a wood lathe, laminate them from plastic, mold them from clay, bake them from dough, etc. Explain to the students that they should be creative and not to worry about craftsmanship. The creativity is the important thing to look for in each design.

Limit the students to a week to work on the design and construction. Be sure to break the class into various groups, this way you will gather more ideas. Keep all work and evaluate it on a creative basis.

If the students come up with some practical ideas, you may wish to use these for an enterprise or mass production project. There is a possible solution to the problem on the following pages. This could be used as the designs for a production product.

A Possible Solution to the Problem
(To be presented after the first week
if a better solution is not found)

Materials:

1. Sample yo-yos
2. Plaster of paris
3. Plastic resin
4. Catalyst hardner
5. Silicone spray mold release
6. Plastic dye
7. 1/4" x 3/4" metal rod per yo-yo (1/4" dia. x 3/4" long)
8. Drill press
9. 9/32" drill bit
10. 1 yo-yo string per yo-yo
11. Casting frame
12. 4 small C-clamps
13. Paper cups
14. Popsicle sticks

Procedures:

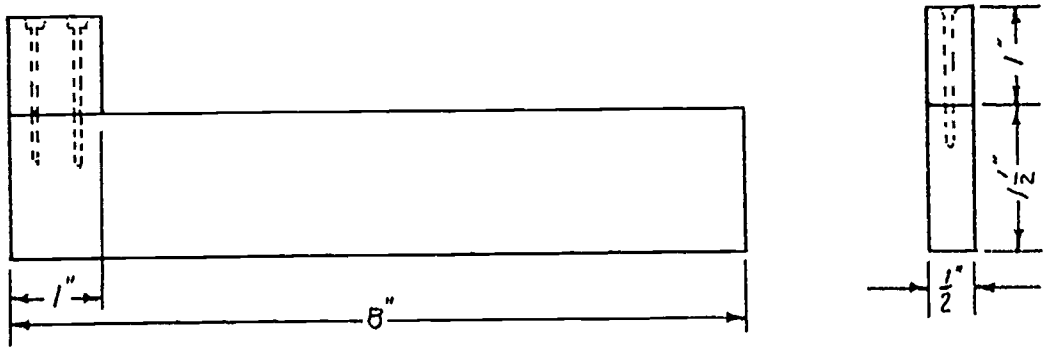
1. Open the class discussion by mentioning the possibility of making yo-yos. Discuss the styles of yo-yos that exist and the materials from which they can be made. Have the students bring in samples of different yo-yos to the next class.

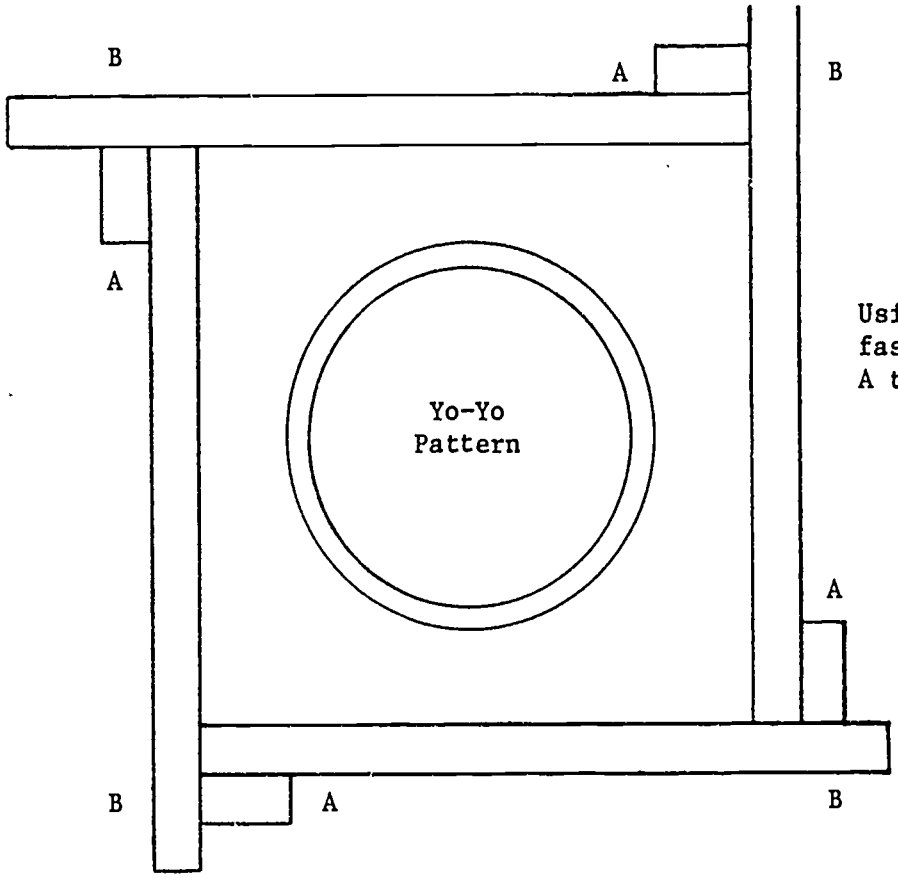
2. Decide what style of yo-yo the class will make. Also decide how many you will produce. Will you make just enough for each class member or will you want to sell them?

3. Using the above materials, calculate the amount of each supply you will need.

4. Disassemble the original yo-yo (the one you are going to make) so you can cast a plaster mold of it.

5. Using a wood frame constructed as shown below, prepare to make a plaster mold of the yo-yo.





Using C-Clamps, fasten all points A to points B.

6. Using C-clamps, clamp the sides of the mold together as shown.

7. Place the mold onto a sheet of glass, metal, or plastic. Clean the surfaces of the mold and the sheet you have selected to place it upon with mold release.

8. Apply a thin coat of mold release or grease onto the surfaces.

9. Do the same with the half of the yo-yo.

10. Center the yo-yo half in the molding frame. Be sure that you have the largest and flat side of the yo-yo placed on the sheet of (plastic, glass, or metal). This will insure that it will come out of the mold.

11. Mix the plaster of paris with water. Be sure to stir it quickly to remove all the lumps. Do this quickly or the plaster will harden. Pour the plaster into the molding frame. Be sure that you have made enough to fill the entire frame. When it begins to harden, level the top with a small metal bar. Allow this mold to sit and harden overnight.

12. Do the same with the other half of the yo-yo. You may wish to make many molds.

13. After the molds have set overnight, remove the frames from around the mold. Next remove the half of the yo-yo you have cast. You may have to lightly tap it or push on its sides with your fingers. Usually the yo-yo will fall out if you turn the mold up-side-down and tap it with your hand.

14. With a clean rag wipe the mold out after you have removed the yo-yo pattern.

15. Take a measuring cup and place water into it until you have exactly five ounces. Get two matching molds that would make one complete yo-yo. Pour the water into the yo-yo molds until they are both filled. See how much water is left in the cup. Subtract this from five and you will know the size of the mold. Here you are seeing how much plastic will be required to cast the yo-yo. Record this number on the mold set.

16. Pour out the water and dry the molds. You are ready to begin casting.

17. Get the matching sets of molds to make one complete yo-yo. Take the bottles of plastic resin, catalyst hardener, and dye.

18. Pour the required number of ounces of plastic resin into a paper cup (this should now be labeled on the matching molds). Add a few drops of coloring dye to the resin and stir it with a popsicle stick. Stir until the plastic is one true color. When doing this only add a few drops at a time.

19. Spray the mold with silicone spray mold release.

20. Read on the bottle of plastic resin the number of drops of catalyst needed to harden the number of ounces of resin you are using. Add this number of drops and quickly stir it into the colored plastic. Quickly pour this into your molds.

21. Allow this to set until it hardens.

22. Remove the cast yo-yo from the mold. This may require tapping or pushing on the edges.

23. Wipe the mold clean and begin the procedure over again to produce more yo-yo's. The more plaster molds you have, the more yo-yos you can produce.

24. The next step involves cutting the metal rods to size. You may want to use a hack saw or other metal cutting tools and machines. Each rod should be 1/4" x 3/4".

25. Another step is the drilling of the holes in the yo-yos so they can be fastened together. When drilling, place the yo-yo halves in a mold and construct a fixture that will position the mold on the table of the drill press. Also position the stops on the drill press so the bit will only drill into the plastic 1/4".

26. Drill the holes into the yo-yos with a 9/32" bit.

27. Assemble the yo-yos. You can tap the rods into the holes and push them together. You may also want to glue the parts together.

28. Assemble the strings onto the yo-yos.

29. Test them to see how they work.

30. Again, determine if you are going to sell them or only make them for the class.

A Teacher Directed
Problem Solving Activity

Prepared as an Aid in Implementing
The Wisconsin Guide to Local Curriculum
Improvement in Industrial Education, K-12

Marooned in the Past

Pertaining to Field Objective One
and the following elements of industry

Research and Development Materials

Communications Human Resources

Power and Energy

Produced by:

The Industrial Education Instructional
Materials Development Project
University of Wisconsin-Stout
Menomonie, Wisconsin

Project Director:

Lawrence S. Wright, Ed.D.

Assistant Director:

M. James Bensen, Ed.D.

Project Coordinator:

Rob Fieldman

Contributor to This Package:

Rob Fieldman

Supported by:

The Wisconsin Department of Public Instruction

The Graduate College and the Center for Vocational,
Technical and Adult Education
Both of the University of Wisconsin--Stout

Marooned in the Past

To the student:

You and your fellow engineers and scientists have perfected a cosmic molecular transporter. This fantastic machine will transport any object, including a man, through time.

It would be impossible to tell if an object had been transported because the object could not communicate its findings to man.

You, then, have volunteered to be the first human to travel through time. You will travel into the past. And even though the years will pass in seconds you will not move from the spot where you are presently standing.

The machine may malfunction and in such a case you may be required to spend a year (or more) marooned in the past. In addition, the controls of the transporter are a little sloppy and you will probably journey back anywhere from 500 to 10,000 years in the past.

The following list represents the articles you can take with you on your journey (most compatible molecular structure with the cosmic transporter). Your task is to place them in order of their importance or priority and then decide on which ones you will take with you.

a life raft
a flashlight and extra batteries
set of encyclopedias
spare clothing
100 feet of rope
pocket knife
an axe
a tent
pots and pans
a deck of playing cards
a set of hand tools
a motorcycle
any other item
fishing equipment
a rifle and 100 shells
a can of gasoline
canned foods
portable radio
money
a small steam engine
a small gasoline engine
a radio (transmitter and receiver)
portable T.V.
The Boy Scout Handbook
can opener
a jeep
10 speed bicycle

After you listed your choices in rank order, eliminate all but the first five choices and explain why they should have priority over the others!

GOOD LUCK - HAVE FUN - BON VOYAGE!!!

*From Engineering Concepts Curriculum Project, Chapter 5, Pages S050101-4

A Teacher Directed
Problem Solving Activity

Prepared as an Aid in Implementing
The Wisconsin Guide to Local Curriculum
Improvement in Industrial Education, K-12

Metrication

Pertaining to Field Objective One
and the following elements of industry

Research and Development Production

Maintenance and Services Human Resources

Power and Energy Communications

Produced by:

The Industrial Education Instructional
Materials Development Project
University of Wisconsin-Stout
Menomonie, Wisconsin

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Both of the University of Wisconsin--Stout

Metrication

Problems to be presented to the Student:

A. It won't be long until our country drops the English system of measurement (inches, miles, pounds) and adopts the Metric system (millimetres, kilometres and kilograms). You may have already used the Metric system at home or in other classes. But chances are, you still aren't as familiar or confident with the Metric system as you are with the English system.

You are going to have an opportunity to experiment with the Metric system by designing a product using only metric measures. You may also choose to convert the measurements of an existing plan sheet from English to Metric measures and then construct the product using the Metric system.

Or another alternative is to measure the dimensions of your classroom, convert the scales on the powertools, convert the dimensions of materials or convert other measuring devices to metric notation.

Make sure that you label your product or the distances and objects you have measured so that other students and teachers will benefit from your findings.

Maybe you can convince your instructor to allow you and your classmates to use only the Metric system in your class!!

B. Have you ever tried to stump your friends with a good riddle or saying?

If you have, you will have fun substituting metric measures in "sayings" that use the English system. Here are some examples!!!

"Give him an inch and he'll take 1, 6 kilometres"!
OR
"He was 25, 4 millimetreing his way to the top".
OR
"An ounce of prevention is worth 454 grams of cure".

Collect as many examples as you can. You may want to use the conversion tables that are included with the handout.

You can now print your "sayings" on posters and display them in the shop and throughout the school. Be sure to ask your other instructors if they would like a "Metric Poster" in their classroom.

C. How long is a kilometre?? How long is 500 metres?? How long is a metre??

Because you will be working with the Metric system, you will probably have an idea of how long these distances really are!! But what about other students? Shouldn't they know the length of a kilometre, too.

You can help your teachers and other students become familiar with common metric lengths. Your first task will be to measure the distances. Then devise a method that will show others how long your distances are. You might have them follow the letters of the alphabet from A to Z. When they reach "Z" they will have walked one kilometre. You will probably think of many better ways to develop your "Metric Treasure Hunt".

The following list of metric units and conversions will assist you in converting from the English system to the Metric system of measurement. Note that a comma is used in place of the decimal point. These conversions are accepted by the International System of Metric Measure.

THE SEVEN BASE UNITS:

Quantity	Name	Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Temperature	kelvin	K
Luminous substance	candela	cd
Amount of substance	mole	mol

Prefix	Symbol	Factor
mega*	M	10^6
kilo*	k	10^3
hecto	h	10^2
deka	da	10^1
deci	d	10^{-1}
centi	c	10^{-2}
milli*	m	10^{-3}
micro*	μ	10^{-6}

*These are preferred units.

CONVERSIONS: (approximate)

symbol	when you know	multiply by	to find	symbol
		LENGTH		
in	inches	25.4	millimetres	mm
ft	feet	305	millimetres	mm
yd	yards	0.9	metres	m
mi	miles	1.6	kilometres	km
		AREA		
in^2	square inches	65	square millimetres	mm^2
ft^2	square feet	0.09	square metres	m^2
yd^2	square yard	0.8	square metres	m^2
mi^2	square mile	2.6	square kilometres	km^2
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
		VOLUME		
fl. oz.	fluid ounces	30	millilitres	ml
pt	pints	0.47	litres	l
qt	quarts	0.95	litres	l
gal	gallons	3.8	litres	l
ft^3	cubic feet	0.03	cubic metres	m^3
yd^3	cubic yards	0.76	cubic metres	m^3
		TEMPERATURE		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

Helpful hints:

0 degree Celsius equals 273° kelvin

1 degree Celsius is equal to 1° kelvin

When writing a long series of numbers, use spaces instead of commas.

Example - 1,348,250 = 1 348 250
English Metric

The centimetre is <u>not</u> a preferred unit of metric measure. Use metres or millimetres. Example - 1 384 mm = 1, 384 m

The comma is used in place of the decimal point.

Example - 1 inch = 25, 4 mm not 25.4 mm

1½ inch = 39, 9 mm

A Teacher Directed
Problem Solving Activity

Prepared as an Aid in Implementing
The Wisconsin Guide to Local Curriculum
Improvement in Industrial Education, K-12

Mousetrap Vehicle

Pertaining to Field Objective One
and the following elements of industry

Research and Development Production

Materials Human Resources

Communications Power and Energy

Produced by:

The Industrial Education Instructional
Materials Development Project
University of Wisconsin-Stout
Menomonie, Wisconsin

Project Director:

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M. James Bensen, Ed.D.

Project Coordinator:

Rob Fieldman

Contributor to This Package:

Rob Fieldman

Supported by:

The Wisconsin Department of Public Instruction

The Graduate College and the Center for Vocational,
Technical and Adult Education
Both of the University of Wisconsin--Stout

For the Teacher

Mousetrap Vehicle

Problem to be presented to the Student:

As the chief designer for a large auto manufacturer, your fellow engineers have just discovered a new and unique power source for transportation. This new power source has many advantages in that it is extremely economical, emits absolutely no polutants because it does not consume petroleum or chemicals for fuel and it produces high energy output for short intervals. The engineers have given you an accurate working prototype (model) of this new power source and oddly enough, it looks just like a mousetrap!

Your task is to design a working prototype (model) of the finished vehicle using a mousetrap as the power source. As the designer, you must consider a variety of factors, including: size, shape, weight, cost, speed, capacity, simplicity and practicality. It may be some time before your company is ready to change over to mousetrap power. You should, therefore, use production methods and materials that are currently available.

(optional) Make drawings of the finished vehicle showing the dimension and materials used for the finished model. Your drawings should describe the model well enough so that someone else could fabricate the model with no further communication from you. Finally, construct the mousetrap vehicle as you have designed it.

You might want to compare your vehicle with other prototypes designed by your company. This can be done through a series of tests or competitions to determine which design is the lightest, fastest, most dependable, etc.

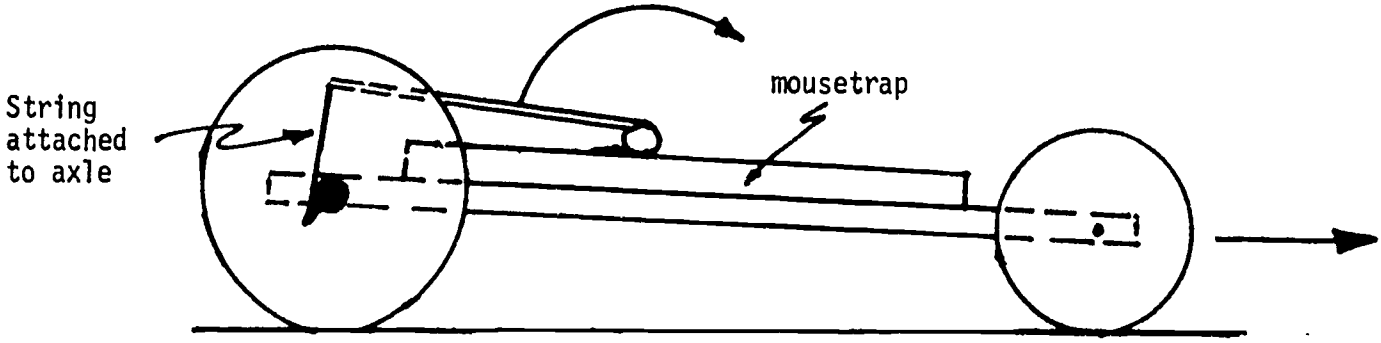
Note to the Instructor:

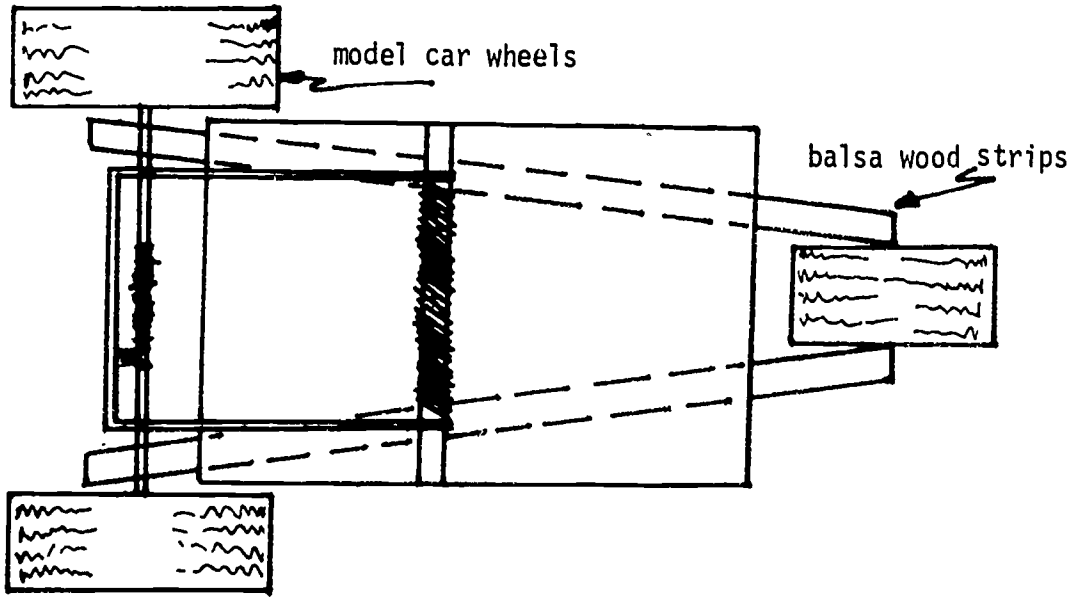
The mousetrap vehicle design project should be presented to the student as a problem for his solution. The process of solving the problem should be encouraged rather than placing emphasis on the finished product. The enclosed drawing represents only one solution. The students should be encouraged to experiment with the mousetrap (modification, disassembly) as well as developing a variety of solutions.

GOOD LUCK!!!!

MOUSETRAP VEHICLE

Possible Solution





A Teacher Directed
Problem Solving Activity

Prepared as an Aid in Implementing
The Wisconsin Guide to Local Curriculum
Improvement in Industrial Education, K-12

The Multi System Encapsulator

Pertaining to Field Objective One
and the following elements of industry

Research and Development Materials

Power and Energy Communications

64/62

Produced by:

The Industrial Education Instructional
Materials Development Project
University of Wisconsin-Stout
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The Graduate College and the Center for Vocational,
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The Multi System Encapsulator*

Problem to be presented to the student:

The common, everyday, run-of-the-mill, ordinary, household mousetrap has frequently been described as a product that cannot be improved. Inventors have been trying for many years to "build a better mousetrap".but they have had little success.

You are going to have an opportunity to redesign the "mousetrap" by creating a "multi system encapsulator". As the name implies, you will be required to use more than one working system for the operation of your "encapsulator". You must use at least three of the five simple machines (pulley, lever, wheel, inclined plane and screw). The simple machines may be connected in any way and you may use any source of energy to initiate the motion of your encapsulator. The mouse, however, must trigger the energy source or start the working cycle.

Your first prototypes (models) need not depend on the quick reflexes of a healthy mouse. It is permissible to use mice that are blind, arthritic, or confined to wheelchairs. This may be extremely important if the cycle time of your encapsulator is more than 1/2 second.

If you find that this problem is easy to solve, try incorporating a rubber band, balloon or small electric motor. If it's still too easy, try using a live, healthy mouse.

GOOD LUCK!!!

and

HAVE FUN!!!!

*From Engineering Concepts Curriculum Project, Chapter 1, Page S010202

A Teacher Directed
Problem Solving Activity

Prepared as an Aid in Implementing
The Wisconsin Guide to Local Curriculum
Improvement in Industrial Education, K-12

Safety Card

Pertaining to Field Objective One
and the following elements of industry

Communications Management

Produced by:

The Industrial Education Instructional
Materials Development Project
University of Wisconsin-Stout
Menomonie, Wisconsin

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The Graduate College and the Center for Vocational,
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Safety Card

To be presented to the student or the instructor:

You have just observed a student in the class perform some operation in an unsafe manner. You want to immediately bring the careless action to his attention by having him think about what he did wrong and as a result, have him become more aware of his own safety as well as the safety of others in the class. You might try giving a copy of this card to the student:

I have just observed you doing something in an unsafe manner. Do you know what it was? How could you have done it in a safer way? How can you prevent it from happening again? Keep this card until you see someone performing carelessly. Then . . give the card to him!!!

To the Instructor:

The instructor or a student can issue the first card and you may want more than one card in each class. The card does not replace a reprimand for serious wrong-doing. It will, however, keep the students on their toes. At the end of the day, nobody wants the card in his pocket.

P.S. CAN YOU AVOID GETTING THE CARD BACK???

A Teacher Directed
Problem Solving Activity

Prepared as an Aid in Implementing
The Wisconsin Guide to Local Curriculum
Improvement in Industrial Education, K-12

Paper Airplane Contest

Pertaining to Field Objective One
and the following elements of industry

Research and Development Production

Materials Human Resources

Communications Power and Energy

6970

Produced by:

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For the Teacher

Paper Airplane Contest

Problem to be presented to the Student:

For many years, airplane manufacturers have been competing against each other in an attempt to build the fastest, biggest, longest flying aircraft. All of the aircraft designers have had to follow rules and constraints and have used similar materials. Why, then, are some planes better than others?

You are going to have an opportunity to answer this question by designing your own paper airplane using the following rules and constraints.

For this contest the CRITERIA for judging are:

distance
time in air
straightness of flight.

The MODEL for this contest is:

a paper airplane.

The CONSTRAINTS limiting how you may build the model are:

one sheet of paper for each airplane
no more than one paper clip for each plane
one-inch of cellophane for each plane
no limit on the number of planes
all flights for each category will be tested by the same person.

The OPTIMIZATION process involves:

designing a plane to meet the criteria as closely as possible
making sure your model includes all the constraints.

Make a paper airplane according to the above rules. You may make one plane that will be good at distance, time, and straightness or you may make two or three separate planes.

Record the information about your planes in the following table. Make as many tests as you wish. The entire class will judge the results after you have finished testing your plane.

The winner will be the person who best meets each of the criteria.

Airplane	Distance (Feet)	Time (Seconds)	Straightness (Distance from Center Line)
1			
2			
3			
4			
5			

A Teacher Directed
Problem Solving Activity

Prepared as an Aid in Implementing
The Wisconsin Guide to Local Curriculum
Improvement in Industrial Education, K-12

The Electro-Magnetic Crane

Pertaining to Field Objective One
and the following industrial elements

Research and Development Production

Materials Power and Energy

Human Resources Communications

74/75

Produced by

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Materials Development Project
University of Wisconsin-Stout
Menomonie, Wisconsin

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Thomas Burt

Supported by:

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The Electro-Magnetic Crane

To the teacher: The following should be read to the class.

In order to demonstrate how electricity can be used in combination with mechanical devices, you are assigned to design and construct a small functioning model of an electro-magnetic crane. These are the types of cranes often used in salvage yards or in other operations to pick up steel and iron scrap. Their operation is somewhat similar to large excavating power shovels (you may have called them steam shovels). But, rather than scooping up materials, the electro-magnetic crane uses a large electro-magnet which, when energized, has a powerful attraction for iron and steel. The magnet then, holds the material until it is moved to the proper point. Power is cut from the magnet and the load is released.

In your design of a small model of such a crane, you should aim for a device which can pick up small iron and steel objects and move them short distances to where they can be dropped into waiting model railroad cars, trucks, etc. You should use flashlight type batteries for powering the electro-magnet, and pine lumber for the body of the crane.

Encourage the students to use innovative ideas in designing the crane. Some of them may want a crane that could be used as a part of a model railroad layout. Although the crane must function properly to illustrate the principles involved, it may be a good idea to stress the creative process rather than high standards of craftsmanship.

When the design is completed and the model built, spend some time discussing the electro-magnetic crane. Cover the problems the students

had with their model and try to get them to think of the problems associated with the design and use of a real industrial electro-magnetic crane. Cover safety, strength requirements of the boom arm, mobility, etc.

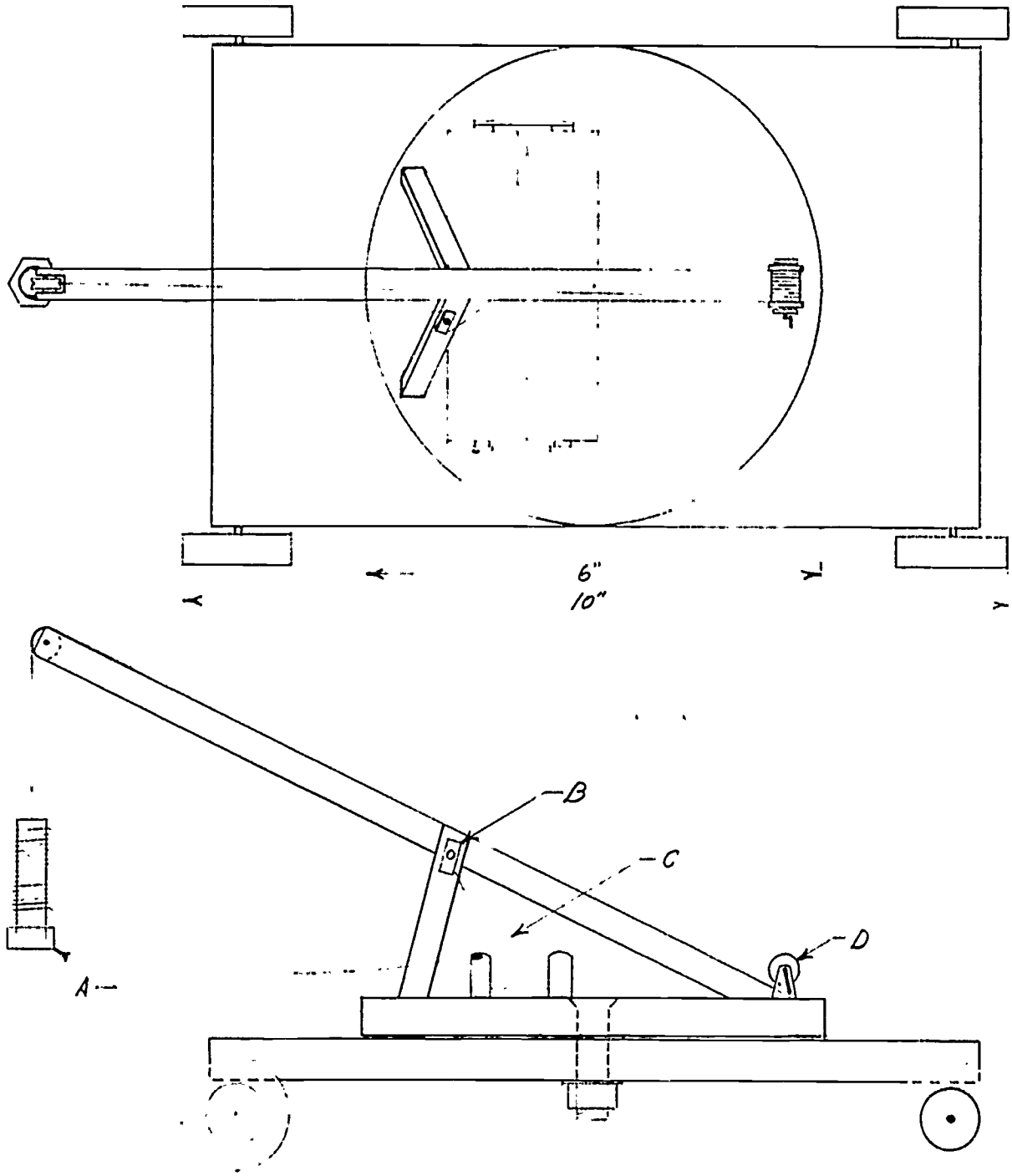
ELECTRO-MAGNETIC CRANE

A. Iron bolt wound with 150 turns of insulated wire for electro-magnet

B. Momentary contact push button switch for energizing electro-magnet

C. Four "D" flashlight cells connected in parallel

D. Winch for raising and lowering electro-magnet



A Teacher Directed
Problem Solving Activity

Prepared as an Aid in Implementing
The Wisconsin Guide to Local Curriculum
Improvement in Industrial Education, K-12

Egg Craft

Pertaining to Field Objective One
and the following elements of industry

Research and Development Production

Materials Human Resources

Communications Power and Energy

80/81

Produced by:

The Industrial Education Instructional
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University of Wisconsin-Stout
Menomonie, Wisconsin

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For The Teacher

Egg Craft

Problem to be presented to the Student:

A group of research scientists has recently decided that in the future, spacecraft returning from interplanetary missions will land without the aid of parachutes. This will save considerable weight and necessity for intricate triggering systems. The new spacecraft will land on the ground and will contain internal and/or external cushioning devices to avoid damage to the space vehicle on impact.

The scientists know that it can be done but they don't want to chance damaging a spacecraft or injuring its passengers. They have concluded that a model is necessary for experimentation. They have also found that a raw egg closely approximates the delicate instruments and mechanisms of the spacecraft as well as the impact tolerance of an astronaut.

Your task is to design a vehicle that will carry a raw egg from a four story (variable) building to the ground without breaking the egg and without the aid of a parachute. You may use any materials or design that you wish. You might also consider the following factors: speed on impact, weight, dependability (will it take more than one impact), stability in flight and practicality.

If your design works, submit it to N.A.S.A. (National Anti-Splatter Administration).

Note to the Instructor:

This problem can yield an infinite number of solutions. Encourage creativity rather than emphasizing craftsmanship. You may find it appropriate to discuss some basic laws of physics while working on this problem such as: terminal velocity, gravity, airfoils, the properties of liquids on impact and bound and rebound characteristics of various cushioning devices. The level of difficulty can be increased by establishing certain criteria . . . the craft must weigh at least two pounds, or no more than 8 oz., it must be aerodynamically stable at terminal speed or the egg must be exposed!!

GOOD LUCK!!!!

A Teacher Directed
Problem Solving Activity

Prepared as an Aid in Implementing
The Wisconsin Guide to Local Curriculum
Improvement in Industrial Education, K-12

Designing a Mobile

Pertaining to Field Objective One
and the following industrial elements

Research and Development Production

Materials Human Resources

Communications

The following industrial elements can also
be incorporated into this activity

Marketing and Distribution

Finance and Management

Produced by

The Industrial Education Instructional
Materials Development Project
University of Wisconsin-Stout
Menomonie, Wisconsin

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Supported by:

The Wisconsin Department of Public Instruction;
The Graduate College and the Center for Vocational,
Technical and Adult Education, both of the
University of Wisconsin-Stout

For the Teacher

Designing a Mobile

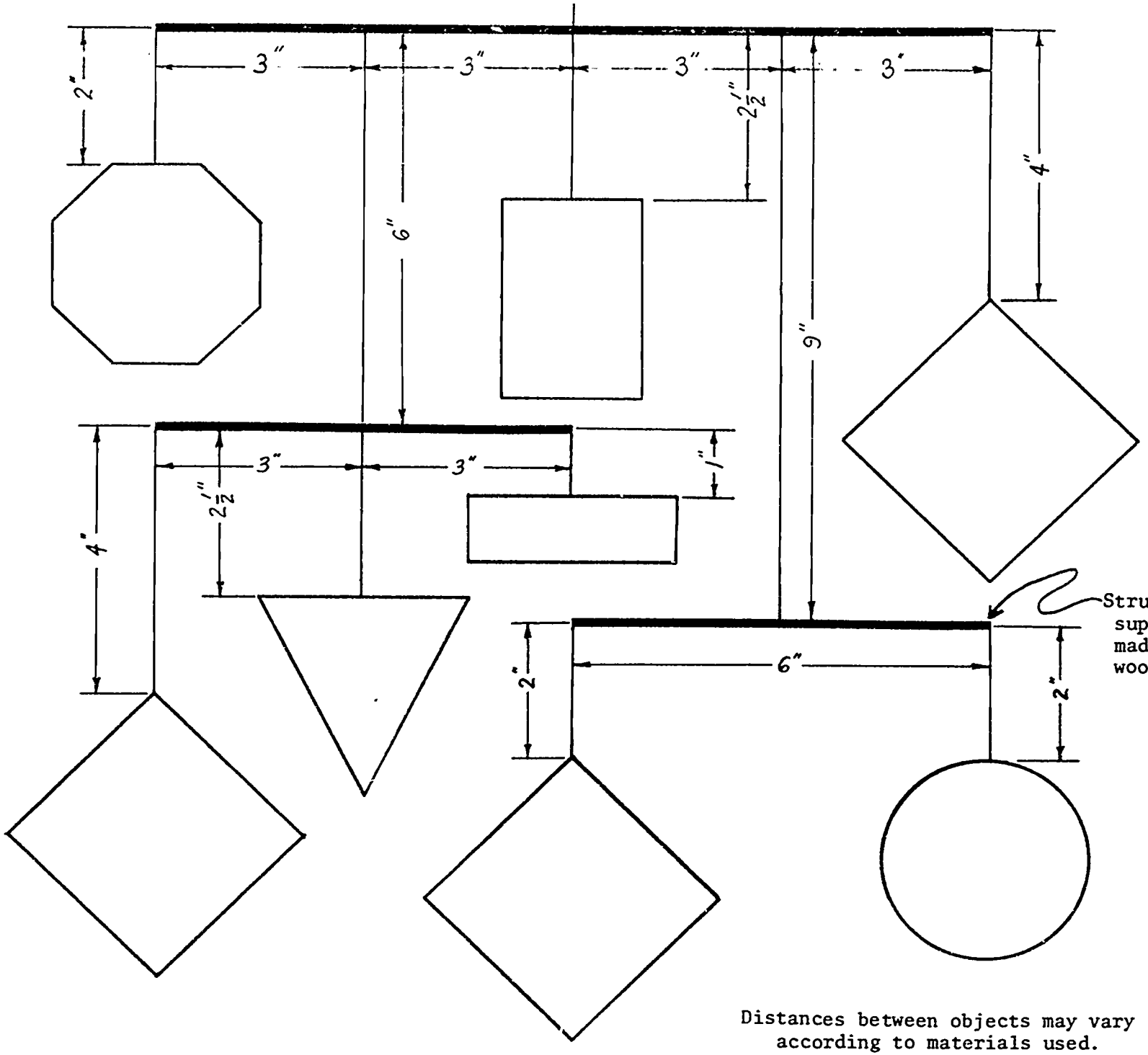
Problem: The problem for this activity is to have the students design and construct a mobile to hang in their room at home.

The students should be instructed that they may use any tools or machines which they have received safe instruction and permission to use. They may also use any materials found in the lab and those they would like to bring from home.

Explain to the students that they should combine creativity and craftsmanship in producing the mobile. They should combine various materials and processes to produce an attractive product. They could possibly use wood, metal or plastic to make the structural support of the mobile. Thread or fishing line could be used to hang the objects from the structure. The objects to be suspended could be processed from clay, wood, metal, paper, or plastic. Processes which could be used to place designs on the suspended objects could be silk screening, painting, forming, etc.

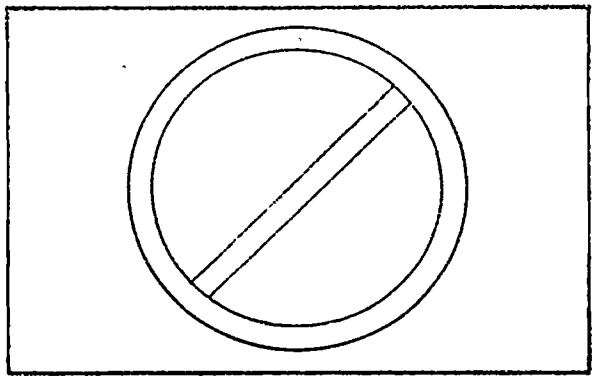
Limit the students to a week to work on the design and construction. Be sure to break the class into various groups, this way you will gather more ideas. Keep all work and evaluate it on a creative and craftsman basis.

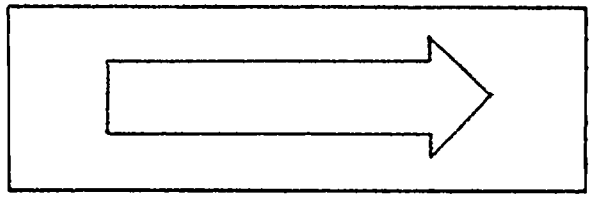
If the students come up with some practical solutions, you may wish to use these for an enterprise or mass production project. There is a possible solution to the problem on the following pages. It can be modified so your class can use it. The length of thread and distances where they are located may need to be moved so the structure will balance, depending on the types of materials used.

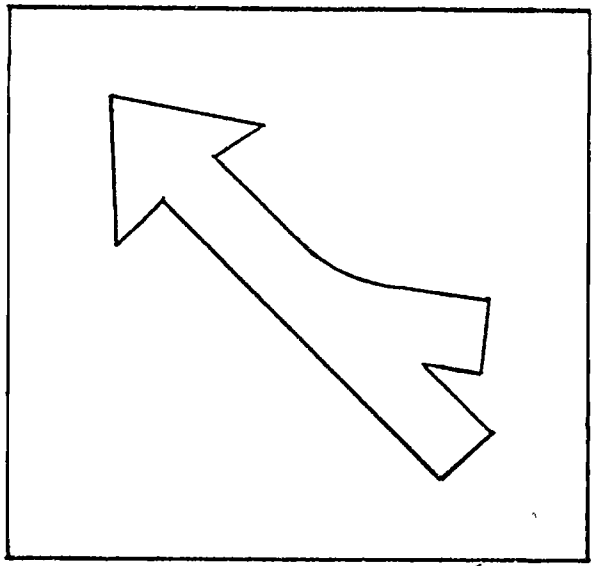


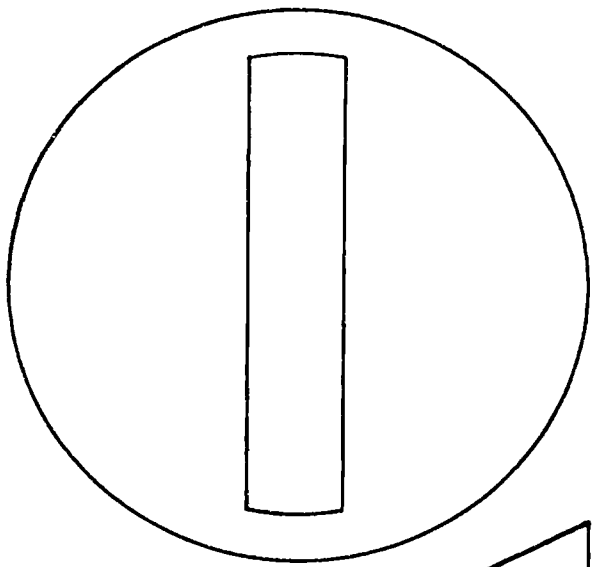
Distances between objects may vary according to materials used.

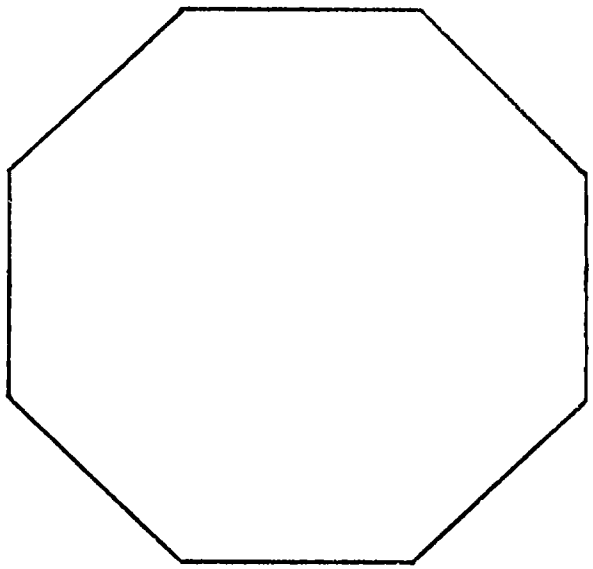
Possible designs for mobile objects.
International Traffic Signs

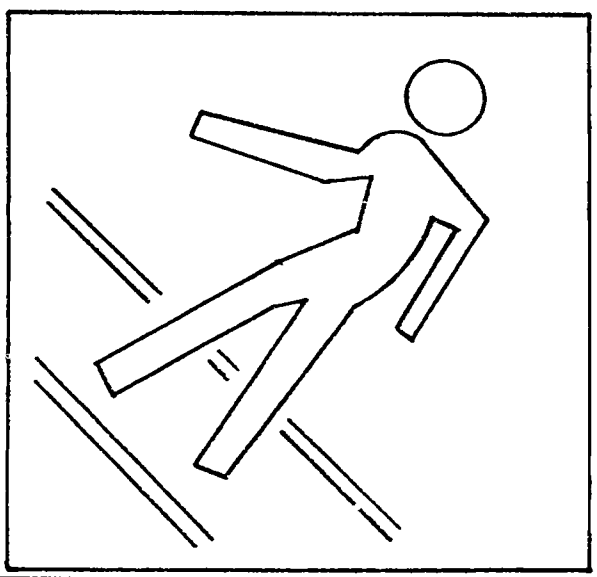


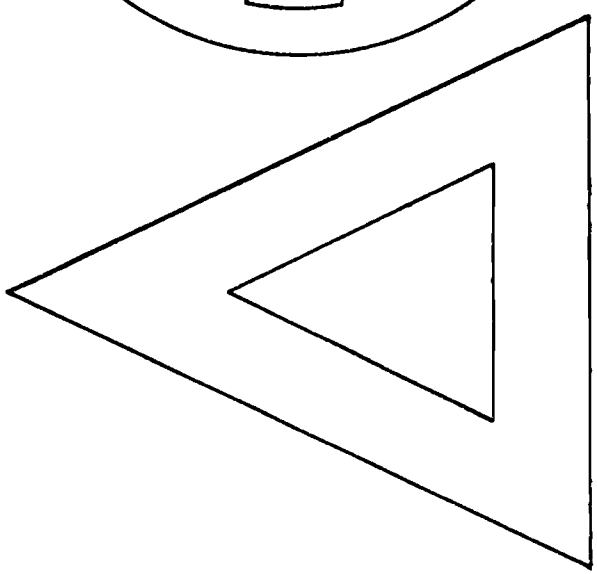


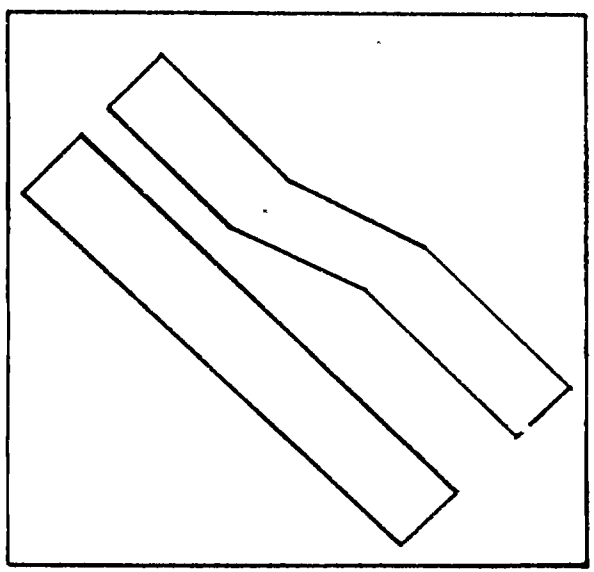












A Teacher Directed
Problem Solving Activity

Prepared as an Aid in Implementing
The Wisconsin Guide to Local Curriculum
Improvement in Industrial Education, K-12

Compressed Air Propulsion

Pertaining to Field Objective One
and the following elements of industry

Research and Development Production

Materials Communications

Power and Energy

91/91

Produced by:

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To The Instructor

Like other problem solving activities, this will yield a variety of solutions. It is suggested that student creativity be emphasized rather than high standards of craftsmanship in production of prototypes.

You may also find it necessary to develop your own criteria for this problem based on class size, student age and ability or intended difficulty of the problem.

Compressed Air Propulsion

Problem to be presented to the student.

Have you ever imagined yourself speeding through outer space? Have you ever dreamed of designing a vehicle and its propulsion system that would make all other systems obsolete?

In light of the current energy crisis, much attention has been given to alternate sources of power, fuel and energy. Many new inventions are currently available that claim to use small amounts of energy or fuel and are low in harmful emissions. Many of these "new" ideas, however, are simply old ideas that are redesigned or renamed. You are going to have an opportunity to design a vehicle using a power source that is very old but has always been non-poluting.

Your task is to design a vehicle that will operate using compressed air as an energy source. Your container for the compressed air will be a single, large balloon. The compressed air may act directly against the atmosphere (reaction engine) or it may be used to power an auxiliary driving mechanism that will move the vehicle.

Before you begin, it may be helpful (and more exciting) to determine the criteria (rules) that all of the other designs should follow.

Here are some suggested criteria:

A. Design the vehicle for maximum speed over a given distance.(or)

B. Design the vehicle to travel the greatest possible distance.

C. Specify that the vehicle weigh no more than 8 oz. but no less than 2 oz.

d. To increase the difficulty of this problem require that the compressed air act on another mechanism to drive the vehicle.

E. Specify whether the vehicle is to be used on land, water, air or any combinations of the three.

F. Allow only one week to invent, design and construct your vehicle.

G. Use more than one balloon!

GOOD LUCK!!!

and

HAVE FUN!!!!